SHAFT FOR GOLF CLUB

Cross-Reference to Related Application

This application is a continuation application of U.S. patent application serial No.: 09/569,247, filed May 11, 2000, and which is hereby incorporated by reference in its entirety.

BACKGROUND OF THE INVENTION

Field of the Invention

This invention relates to a golf club shaft.

Description of the Related Art

A usual gold club is made such that its shaft is formed into a hollow shaft under application of high strength high resilient fiber (for example, a carbon fiber) so as to reduce its entire weight, wherein an initial speed of a golf ball and a carry of the golf ball are improved by increasing a head speed due to a deformation (bending) of raw material of the golf club during its swing and increasing a repelling force generated when the deformed shaft is recovered to its original shape. In addition, as a trend of the recent golf club, the club head is made to have a large size and a setting of low center of gravity, the shaft is changed into a long and soft shaft and then the head speed and the repelling force are increased to improve the initial speed of the ball as well as its carry.

In addition to the aforesaid head speed or the repelling force, as a factor for increasing the carry, it is known in

the art that the initial speed of the ball is improved more effectively to extend the carry by striking the ball 103 at an upper location than a crossing point of a perpendicular suspended from the center of gravity 101 of the club head 100 as shown in Fig. 9.

This is a so-called vertical gear effect, wherein a counter-clockwise couple 105 is generated at the club head 100 due to shock in a direction of an arrow 104 generated when the ball 103 strikes against the club head 100 advancing forward in the direction of arrow 102 at the time of impact and then this couple 104 causes the shaft 106 to be crushed in a direction of an arrow 107.

That is, a relation between the couple 105 of the club head 100 and a deformation of the shaft 106 causes the ball 103 to be rotated in a clockwise direction, resulting in that a back-spin influencing against a carry is reduced and a striking angle is increased, and nowadays there is provided a countermeasure in which a size of the club head 100 is increased in a vertical direction and concurrently a low center of gravity of the club head is set.

However, as a result in which the low center of gravity or large size setting of the club head 100 described above was promoted, a deformation of the shaft 106 caused by the

couple 105 at the time of impact was excessively increased as shown in Fig. 8 and also the loss of energy caused by deformation of the shaft 106 was excessively increased, resulting in that there was a certain limitation in increasing the initial speed of the ball.

The present invention has been invented in view of the aforesaid circumstances in the prior art and it is an object of the present invention to provide a golf club shaft in which the shaft is properly flexed at the time of swing, an excessive deformation of the shaft is restricted at the time of impact, the initial speed of the ball is improved while a high repelling force is being generated, thereby a carry is further improved and the shaft is quite suitable for application of the club head having a low center of gravity or a large size.

SUMMARY OF THE INVENTION

The present invention has employed the following technical means in order to accomplish the aforesaid object.

In accordance with the technical means in first aspect, there is provided a golf club shaft in which the entire inner region of the hollow shaft is filled with resilient material having a feature in which a rapid application of force causes a high repelling force to be acted on it to be hardly deformed and in turn a gradual application of force causes the shaft

to be easily deformed.

In accordance with the technical means described in first aspect, the resilient material filled in the shaft may act on deformation of the shaft.

That is, since the gradual application of the force is applied to the shaft at the time of swing, the filled resilient material may easily be deformed to assure a flexing of the shaft when the shaft is swung. In addition, at the time of impact, a rapid application of the force is applied to the shaft by a shock where the ball strikes against the club head, so that a high repelling force is generated at the filled resilient material to cause it to be hardly deformed and in turn the repelling force of the resilient material may act as a repelling force for the shaft at the time of impact and concurrently a deformation of the shaft is restricted by the repelling force to reduce an energy loss generated at the time of impact.

Although the technical means described in first aspect as above is set such that the resilient material is filled in the entire shaft, this is not limited to this constitution but it may be filled at the part of the shaft.

For example, as disclosed in the technical means described in second aspect, there is provided a golf club

shaft filled with resilient material having a feature in which if a rapid application of the force at the inner extremity end of the inner shaft causes a high repelling force to be acted on it to cause it to be hardly deformed and in turn if a gradual application of force at the inner extremity end of the inner shaft causes the material to be easily deformed.

That is, the extremity end portion of the shaft is a part where the deformation caused by a couple at the time of impact may easily be produced and also mostly influence a carry of the ball as well as its characteristic of flying direction, resulting in that filling of the resilient material in the shaft may cause the same action as that of first aspect.

As a practical range of the extremity end, it is preferable that the range of the extremity end where the resilient material is filled is from 30 cm to 40 cm from the neck end or from near the end part as disclosed in the technical means in third aspect.

In the foregoing description, although both restriction against the excessive deformation of the shaft and assuring of the repelling force of it are assured only with the resilient material, it may also be applicable that a core rod is stored within the shaft along its axis, the lower

end of the core rod is fixed to the extremity end of the shaft and at the same time the core rod is inserted into the resilient material to assure restriction of excessive deformation of the shaft as well as repelling force as disclosed in the technical means of fourth aspect.

In accordance with the technical means of fourth aspect, a repelling force from the deformation where the resilient material is crushed with the core rod from inside is added to the repelling force attained from the deformation caused by the deformation of the shaft at the time of impact of the resilient material. That is, the repelling force of the resilient material may act against both shaft and core rod, resulting in that both restriction of the excessive deformation of the shaft and assuring of the high repelling force can be carried out more effectively.

Further, as described in the technical means of fifth aspect, the fixed state of the core rod and the resilient material through adhesion enables both restriction against the excessive deformation of the shaft and assuring of the high repelling to be carried out more effectively and further a certain deformation of the core rod is produced by deformation of the shaft, although the resilient material integrally assembled with the core rod is deformed in

concurrent with the core rod, so that the repelling force of the resilient material can be transmitted to both shaft and core rod without producing any time loss.

In addition, the resilient material may be adhered or fixed to the shaft as disclosed in the technical means of sixth aspect and in accordance with this feature, the repelling force of the resilient material may act against a twisting of the shaft to cause the shaft to be hardly twisted and so this is effective in view of improving its direction-oriented feature.

The resilient material is not limited to one in which its entire material is adhered and fixed to the shaft, but its part is adhered and fixed to the shaft, wherein as disclosed in the technical means of seventh aspect, for example, it can be applied that the upper end of the resilient material is adhered to and fixed to the shaft, and as this constitution, an assembly in which the resilient material is filled at the extremity end of the shaft as disclosed in second and third aspects is preferable.

As the resilient material in the present invention, it includes all the materials having such a feature as one in which a rapid application of the force causes a high repelling force to be acted and causes the material to be hardly deformed

and in turn a gradual application of the force causes the repelling force to be weakened and causes the material to be easily deformed and more practically it is preferable to apply the resilient material of high molecular system.

Further, more practically, following resilient materials can be applied.

For example, they are polyurethane (foam under mixture of polyisocyanate and polyol), polyethylene (foam), polystylene (foam), latex foam, foamed rubber, pouncing putty (immersed with siloxane containing boron atom), and further butadiene-acrylonitrile copolymer, chloroprene polymer, ethylene propylene copolymer, acryl copolymer, stylene-butadiene copolymer, isobutylene-isoprene, polybutadiene, natural polyisoprene, synthetic polyisoprene, natural rubber, rubbers of polyvinyl chloride, rubbers of polyamide, polyvinyl copolymer, polyolefins, synthetic rubber, propylene, nitrele, isoprene, silicone, uria, phenol, foams selected from these substances or mixed with these substances.

The shaft of the present invention is constructed such that the resilient material may easily be deformed at the time of swing, so that it is satisfactory if the resilient raw material substantially deformed at the time of swing is used

to increase the head speed at the time of swing and further it is the most applicable case that the resilient raw material of as soft as possible and in particular it is satisfactory that the material is used at the extremity end of the shaft.

Additionally, the method for filling the resilient material in the shaft is optional and as its example, the resilient material is formed into the shape corresponding to the inner portion of the shaft and inserted into the shaft. In the case of the club shaft in which the core rod is provided, the resilient material may be inserted into the shaft under a state in which the resilient material is being fixed to the core rod or the resilient material formed into the shape corresponding to the inner portion of the shaft may be inserted after the core rod is fixed to the shaft.

In order to make an inserted state of the core rod and the resilient material, it is possible to insert the core rod into the resilient material or wind the resilient material around the core rod or to perform a direct foaming within the shaft.

In Table 1 (the prior art product) and Table 2 (the present invention) are indicated the results in which the initial speed of the ball and the carry of the ball in the golf club where the prior art shaft and the shaft of the present

invention were used were measured by the following methods.

Measuring method: A ball is hit in a specified swing speed (50 m/s) by a golf club swing mechanism made by Miyamae Co., Ltd. an initial speed (m/s) of the ball is measured by a trajectory measuring machine made by Bridgestone Sports Co., Ltd. and a flying distance (carry) is measured by a computer simulation in reference to the speed.

Configuration of the applied clubs:

Shafts: Both prior art product and the product of the present invention:

Full length of 1143 mm and weight of 55 g made of similar carbon fiber having the same number of plies

Club head:

Both prior art product and the product of the present invention have a loft angle of 10.5° , a lie angle of 55° and a weight of 193g

The resilient material (only the product of the present invention):

Raw material : foamed polyurethane

Density : 0.3 (g/cm^3)

Asca C hardness : 33

Repellent resiliency : 50(%)

Compressive residual strain: 4 (%)

Amount of use : 30 cm at the extremity end

[Table 1]

	1	2	3	4	5	6	7	8	9	10	AV
Head Speed	50	50	50	50	50	50	50	50	50	50	50
Ball Speed	67	66	65	64	64	63	63	65	64	65	65
Carry	226	225	218	207	221	205	216	225	221	222	219

[Table 2]

	1	2	3	4	5	6	7	8	9	10	AV
Head Speed	50	50	50	50	50	50	50	50	50	50	50
Ball Speed	69	68	68	69	68	68	68	67	68	67	68
Carry	247	237	245	241	247	246	247	234	242	242	243

In view of the result of measurement described above, it has been proved that the product of the present invention exceeded as compared with that of the prior art in reference to the ball speed by a maximum value of 6 m/s and an average value of 3 m/s and the constitution of the present invention was quite effective for improving the initial speed of the ball. In addition, as to the carry, the present invention was substantially improved over the product of the prior art by the maximum value of 42 m and the average value of 24 m.

EFFECTS OF THE INVENTION

As proved in reference to the aforesaid result of measurement, the present invention can provide a golf club

shaft having the initial ball speed and the carry quite improved by filling the resilient material having a characteristic in which it is hardly deformed under an action of the high repelling force upon rapid applying of force to the inner side of the shaft and in turn it is easily deformed upon gradual application of the force.

In addition, both restriction over the excessive deformation of the shaft and assurance of the repelling force can be carried out more effectively by the inventions described in fourth and fifth aspects, so that it can be expected to have more improved initial speed of the ball and the carry.

Additionally, since the resilient material can be acted against the deformation of the shaft in a twisting direction by the inventions of sixth and seventh aspects, this is quite effective for stabilizing the directional characteristic of the ball, resulting in that the present invention becomes the golf club shaft in which not only the initial speed of the ball and its carry can be improved but also it has a quite superior directional characteristic.

BRIEF DESCRIPTION OF THE DRAWINGS

Fig. 1 is an elevational view with a part being broken away to show a substantial part of a golf club in which the

golf club shaft of the present invention is used.

Fig. 2 is an enlarged sectional view taken along line II-II of Fig. 1.

Fig. 3 is an operational view for showing a deformation state of the shaft ranging from its down-swing state to its impact state.

Fig. 4 is a side elevational view with a substantial part being broken away for showing a deformation state of the shaft at the instant time of impact.

Fig. 5 is a side elevational view with a part being broken away to show a substantial part of the golf club in which the golf club shaft of another preferred embodiment of the present invention is used.

Fig. 6 is an enlarged sectional view taken along line II-II of Fig. 5.

Fig. 7 is a side elevational view with a substantial part being broken away to show a state of deformation at the instant time of impact in the shaft shown in Fig. 5.

Fig. 8 is an operational view for showing a state of deformation in the prior art shaft ranging from its down-swing to its impact.

Fig. 9 is a side elevational view for showing a state of deformation of the prior art shaft at the instant time of

impact.

DETAILED DESCRIPTION OF THE PREFERRED EMBODIMENTS.

Referring now to the drawings, some preferred embodiments of the present invention will be described as follows, wherein Figs. 1 and 2 illustrate a golf club A which the golf club shaft 1 of the present invention is used. At first, the constitution of the golf club A will be described.

The shaft 1 is of a hollow structure in which a plain sheet of high strength high resilient fiber (for example, carbon fiber) immersed with synthetic resin or high strength high resilient filaments immersed with synthetic resin is wound. Since this structure is of a well-known structure, its detailed description will be eliminated.

Reference numeral 2 denotes a club head, wherein the well-known raw material (for example, titanium) is formed into a predetermined shape and the shaft 1 is inserted and fixed to the neck part 3 integrally arranged at its upper surface.

Reference numeral 4 denotes a resilient material which is filled in the shaft 1 within a range of 30 cm from the upper end 31 of the neck part 3 toward the upper part of the shaft 1, its upper part is adhered to and fixed to the inner surface of the shaft with adhesive agent 5 over its entire

circumference.

The resilient material 4 is of high-molecular system having a characteristic in which a high repelling force may act on it upon rapid applying of force to cause it to be hardly deformed and in turn a gradual application of the force to it causes the repelling force to be weakened and easily deformed.

Incidentally, one example of the method for filling the resilient material 4 will be described, wherein the resilient material 4 has its outer diameter formed to be larger than an inner diameter of the shaft 1 at a location where the resilient material 4 is filled and after the adhesive agent is coated at the predetermined position, the material is pushed into the shaft at the upper end side or the lower end side (not shown) of the shaft 1 and filled there. As to the filling method, this is not limited to the aforesaid method, but it is also optional to perform it with another method.

Referring now to Figs. 3 and 4, the state of deformation of a series of shafts 1 when a ball 6 is hit by the golf club A constituted as described above will be described.

At first, at the time of down-swing, the resilient material is easily deformed, so that the shaft 1 is properly flexed and this flexing state may increase the head speed.

Next, at the time of impact, a couple D is generated at the club head 2 by the shock in the arrow direction C2 when the ball 6 strikes against the club head 2 advancing forward in the arrow direction C1 as shown in Fig. 4 and then the couple D deforms the shaft 1 to crush it from the arrow direction E.

A period of time when the shaft 1 is deformed at the time of impact is faster than that when the shaft 1 is flexed at the time of down-swing by about 100 to 1000 times, i.e. at the time of impact, a force is rapidly applied as compared with the time of down-swing in which a gradual application of force is applied.

At this time, the filled resilient material 4 is compressed as the shaft 1 is tried to deform and a high repelling force is generated by this compression and then this repelling force restricts the deformation caused by the impact of the shaft 1 to a minimum state and concurrently this repelling force restricts a vibration of the shaft 1. That is, an energy loss at the time of impact is reduced and thereby a repelling force of the shaft at the time of impact is concentrated against the ball 6, so that an improvement of the initial speed of the ball and the carry of it is realized.

In addition, since the resilient material 4 is adhered

to the shaft 1, a repelling force may act on the shaft 1 against deformation in a twisting direction of it, so that a stable direction of it is also realized.

Figs. 5 and 6 show a golf club A1 in which a shaft of another example in the preferred embodiment of the present invention is used. The same portions as those of the aforesaid example are denoted by the same reference numerals and their description will be eliminated.

The golf club A1 of the preferred embodiment is provided with a core rod 7 fixed inside the shaft 1 and passing through the resilient material.

The core rod 7 is formed by a core rod 71 made of raw material which is at least harder than the resilient material and has such a tension as one capable of compressing the resilient material (for example, metal, carbon fiber, glass fiber and hard synthetic resin and the like) and the same length as the entire length of the resilient material 4; and a fixing part 72 at the rear end of the core rod having the same length as the entire length of the neck part 3.

The core rod 71 is formed into a fine rod shape and passes through the resilient material 4 along an axis of the shaft 1. The fixing part 72 is formed to have an outer diameter approximately adapted for an inner diameter of the shaft 1

corresponding to the neck part 3, adhered and fixed with adhesive agent 51.

Incidentally, one example of the method for filling the resilient material 4 in the preferred embodiment will be described, wherein the outer diameter of the resilient material 4 is formed to be larger than an inner diameter of the shaft 1 where the resilient material 4 is filled and a through-pass hole 41 through which the core rod 71 may pass is opened along its axial line. Then, the core rod 7 is inserted at the lower end of it into the through-pass hole 41 and fixed there and adhesive agent is coated at the predetermined positions of the resilient material 4 and the fixed part 72, thereafter it is pushed at the upper end side or the lower end side (not shown) of the shaft 1 and filled. The filling method is not limited to the aforesaid method, but other methods are optionally available.

Then, referring to Figs. 3 and 7, a deformation state of the shaft 1 when the ball 6 is hit by the golf club A1 constituted as above will be described as follows.

At first, at the time of down-swing, the resilient material 4 is easily deformed in the same manner as that of the aforesaid example, so that the shaft 1 is properly flexed and this flexing increase the head speed.

Then, at the time of impact, a couple D is generated at the club head 2 by the shock in the arrow mark direction C2 when the ball 6 strikes against the club head 2 advancing toward the arrow mark direction C1 as shown in Fig. 7 and the couple D deforms the shaft 1 in the arrow mark direction E in such a way that the shaft is crushed.

At this time, to the filled resilient material 4 are acted both a compressing force applied from the outside by the deformed shaft 1 and a compressing force applied from the inside by the core rod 71 having less deformation amount than that of the shaft 1. That is, the resilient material 4 is compressed from both inside and outside, a high repelling force is generated by this compression, this repelling force restricts the deformation of the shaft 1 to a minimum value and at the same time restricts the vibration of the shaft 1. Accordingly, the energy loss at the time of impact is reduced, and thereby the repelling force of the shaft 1 at the time of impact is concentrated at the ball 6, so that the initial speed of the ball and the carry of the ball can be improved by this preferred embodiment.

In the preferred embodiment above, although both golf clubs are illustrated as the wood type, they are not limited to this type but the iron type may also be applicable. In

the case of the iron type (not shown), a long iron type applied when a certain carry is required is the most preferable one.

Having described specific examples of the invention with reference to the accompanying drawings, it will be appreciated that the present invention is not limited to those precise embodiments, and that various changes and modifications can be effected therein by one of ordinary skill in the art without departing from the scope of the invention as defined by the appended claims.